

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029**

Mr. Larry Lawson, Director
Division of Water Program Coordination
Virginia Department of Environmental Quality
629 Main Street
Richmond, VA 23219

Dear Mr. Lawson:

The United States Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Load (TMDL) for the aquatic life (benthic) use impairment on the Unnamed Tributary to the Chickahominy River. The TMDL was submitted to EPA for review in April 2004. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address an impairment of water quality as identified in Virginia's 1998, Section 303(d) list.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDL for the aquatic life use impairment on the Unnamed Tributary to the Chickahominy River satisfies each of these requirements.

Following the approval of the TMDL, Virginia shall incorporate the TMDL into an appropriate Water Quality Management Plan pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.



If you have any questions or comments concerning this letter, please don't hesitate to contact Mr. Peter Gold at (215) 814-5236.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure



Decision Rationale

Total Maximum Daily Loads for the Aquatic Life Use Impairment on Unnamed Tributary to the Chickahominy River

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA's) rationale for approving the TMDL for the aquatic life use (benthic) impairment on the Unnamed Tributary to the Chickahominy River (UT Chickahominy River). EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

- 1) The TMDL is designed to implement applicable water quality standards.
- 2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.
- 3) The TMDL considers the impacts of background pollutant contributions.
- 4) The TMDL considers critical environmental conditions.
- 5) The TMDL considers seasonal environmental variations.
- 6) The TMDL includes a margin of safety.
- 7) There is reasonable assurance that the TMDL can be met.
- 8) The TMDL has been subject to public participation.

II. Background

The UT Chickahominy River Watershed is located in Hanover County, Virginia and is part of James River Basin. The impaired segment runs 1.50 miles from the Tyson Plant discharge to its confluence with the Chickahominy River. The 435 acre watershed is rural with forested (62 percent) and agricultural (15 percent) lands making up 77 percent of the watershed area. However, there is a large poultry facility in this small watershed and commercial and transitional lands account for 15 percent of the watershed, the remainder of the watershed consists of wetlands and open water.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed the UT Chickahominy River (VAP-G05R) on Virginia's 1998 Section

303(d) list as being unable to attain the general standard for the aquatic life use. This decision rationale will address the TMDL for the impairment of the general standard for the aquatic life use. The failure to attain this use was determined through biological assessments of the benthic macroinvertebrate community.

Virginia's 305(b)/303(d) guidance states that support of the aquatic life beneficial use is determined by the assessment of conventional pollutants (dissolved oxygen (DO), pH, and temperature); toxic pollutants in the water column, fish tissue, and sediments; and biological evaluation of benthic community data.¹ Therefore, a biological assessment of the benthic community can be used to determine a stream's compliance with the state's general standard for the aquatic life use. Virginia uses EPA's Rapid Bioassessment Protocol II (RBPII) to determine the status of a stream's benthic macroinvertebrate community.² This approach evaluates the benthic macroinvertebrate communities of the monitored segment and its reference station. Measurements of the benthic community, called metrics, are used to identify differences between monitored and reference stations.³ The state is currently in the process of changing this methodology to a stream condition index (SCI) approach.

As part of the RBPII approach, reference stations are established on streams which are minimally impacted by humans and have a healthy benthic community. These reference stations represent the desired community for the monitored sites. Monitored sites are evaluated as non-impaired, slightly impaired, moderately impaired, or severely impaired based on a comparison of the biological communities of the reference and monitored sites. Streams that are classified as moderately (after a confirmatory assessment) or severely impaired after an RBPII evaluation are classified as impaired and are placed on the Section 303(d) list of impaired waters for TMDL development. The UT Chickahominy River has consistently been assessed as having an impaired biological community and has been on the state's Section 303(d) List since 1994. The RBPII analysis was based on an upstream biomonitoring station on the UT Chickahominy River. Since there was minimal flow in the upstream segment of the UT Chickahominy River, the reference station was changed in 2002 to Grassy Swamp Creek. Current analysis using the SCI approach confirms the results of the RBPII analysis on the UT Chickahominy it also indicates that both reference sites may be impaired as well. Unlike, the RBPII approach the SCI method compares the monitored site to the condition of a reference group.

The RBPII analysis assesses the health of the macroinvertebrate community of a stream. The analysis informs the biologist of the condition of the stream's benthic community. Through the use of the RBPII analysis, the biologist is able to determine if the community is impacted but

¹VADEQ. 1997. 1998 Water Quality Assessment Guidance for 305(b) Water Quality Report and 303(d) TMDL Priority List Report. Richmond, VA.

²Tetra Tech 2002. Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek. Fairfax, Virginia.

³Ibid 2

it does not determine what is causing the degradation of the benthic community. Although further interpretation of the biological community can identify likely stressors, additional analysis is required to determine the pollutants which are causing the impairment. TMDL development requires the identification of the sources of impairment and the establishment of numeric endpoints that will allow for the attainment of designated uses and water quality criteria.⁴ An analysis of water quality data, habitat assessments, and the biological community was conducted to determine the cause of the biological impairment. Low DO, sediment, habitat modification, nutrients, and toxic pollutants were all evaluated as possible stressors to the UT Chickahominy River. Ambient water quality monitoring data (AWQMD) on the UT Chickahominy River and discharge monitoring reports from Tysons documented temperature, DO, pH, turbidity, total suspended solids (TSS), nitrogen, and phosphorous.

To get a better understanding of the DO concentrations during the most critical periods, diurnal DO sampling was conducted on the UT Chickahominy River in September 2003. DO concentrations were measured over a 24 hour period to determine if low DO levels were impacting the biological community. The samples were collected in the summer when the lowest DO concentrations are expected to be found due to a combination of high water temperatures (lower solubility of oxygen) and low flows. The diurnal DO data also captures the impacts of respiration from primary producers on the stream system. During the evening and early morning hours, since there is no sunlight available and consume oxygen, these organisms cease photosynthesis. The early morning period is often the most critical as respiration has been occurring for a longer period of time. The diurnal DO study found that the DO levels remained above the applicable criteria for the entire 24-hour period. It seems as though the discharge from the Tysons facility controlled the DO levels as it makes up a large portion of the flow. The DO levels just below the discharge point stayed between 5 and 7 mg/L for the entire 24 hour period.

A review of the AWQMD found that pH levels downstream of the facility were consistently above the 9.0 standard units which is the state criteria maximum. It was felt that excessive algal growth in the ponds downstream of the Tysons discharge was responsible for these elevated pH levels. As excessive levels of primary producers remove carbon dioxide from the water column in order to maintain photosynthesis, the waters become less acidic. Although pH was not a stressor, it did identify the mechanism that was impacting aquatic life in the UT Chickahominy River. Excessive algal growth, primary production, was having negative effects on the stream. Excessive levels of nutrients are needed to support such high levels of primary production. In order to control the algal levels it was determined that their food source, nutrients, needed to be controlled. Based on this data, it seemed that the algal growth was being controlled by nitrogen. The AWQMD did not demonstrate that phosphorous was the limiting nutrient. It appears that the phosphorous levels are so high that the system is masked to look as though it is nitrogen limited. The stressor identification determined that phosphorous levels needed to be controlled to limit the algal growth which would also lower the pH levels.

Toxicity testing was conducted for water samples collected from the UT Chickahominy

⁴Ibid 2

River. The testing compared the survival and growth rates of fathead minnows (*Pimephales promelas*) and water fleas (*Ceriodaphnia dubia*) in water collected from the impaired site with an unimpaired water source. The tests did document impacts to both organisms which were reared in this water. Toxicity therefore may be a problem associated with the UT Chickahominy River as well. However, a specific compound or substance leading to this toxicity was not identified.

The Commonwealth does not currently have numeric criteria for phosphorous, therefore, an endpoint needed to be determined for the UT Chickahominy River. Numeric endpoints represent the water quality goals that are to be achieved through the implementation of the TMDL which will allow the impaired water to attain its designated uses. In order to determine this end point, the Generalized Watershed Loading Function (GWLF) model was used to determine the annual phosphorous load. This information was placed into the Reckhow model which is used to determine the phosphorus concentration in lakes based on inputs, detention time, and depth. The goal was to achieve a phosphorous concentration that would translate via the Carlson trophic state index (TSI) into a chlorophyll a concentration of 20 ug/l. This chlorophyll a concentration represents a eutrophic condition which would be expected for the downstream pond.

The GWLF model was selected as the means to determine loadings to the streams. The GWLF model provides the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).⁵ GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.⁶ Calculations are made for sediment and nutrients based on daily water balance totals that are summed to give monthly values. The GWLF model was calibrated to the flow data from the United States Geological Survey (USGS) gauge 02036500 on Fine Creek. It was calibrated for a 10 year period and transferred to the UT Chickahominy River.

The phosphorous load was then used in the Reckhow equation to determine the phosphorous concentrations in the pond. Therefore, the GWLF model determined the phosphorous inputs to the pond. The model also required the mean pond depth and hydraulic detention in order to determine the phosphorous concentrations of the pond. The mean depth of the pond was determined based on 12 field measurements taken by VADEQ and the hydraulic detention was determined by dividing the annual inflow to the pond by the volume of the pond. The model then converted the phosphorous concentration into a chlorophyll a concentration through the use of the TSI equations. The TMDL was developed to produce a chlorophyll a concentration of 20 ug/l. A chlorophyll a concentration of 20 ug/l equates to a total phosphorous concentration of 48 ug/l and a TSI score of 60. Virginia's 303(d) listing guidance requires lakes with low DO levels to be listed as impaired when their TSI is above 60. A TSI score of 60 represents the expected eutrophic conditions of a lake. It is believed that if a chlorophyll a concentration of 20 ug/l is met, the pond and UT Chickahominy River will be able to support a

⁵Ibid 2

⁶Ibid 2

healthy benthic community.

Table 1 - Summarizes the Phosphorous Allocations for the UT Chickahominy River

Stream	Pollutant	TMDL (lbs/yr)	WLA (lbs/yr)	LA (lbs/yr)	MOS*(lbs/yr)
UT Chickahominy	Phosphorous	432	409	23	Implicit

* Virginia includes an explicit MOS by reserving the 10 percent of total loading to the MOS.

The United States Fish and Wildlife Service has been provided with a copy of the TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing aquatic life use (benthic) impairment TMDL for the UT Chickahominy River. EPA is therefore approving this TMDL. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

The impaired segment was listed as impaired due to a degradation of its benthic macroinvertebrate community. As mentioned above, benthic assessments inform the biologist of an impairment, but they are unable to identify stressors conclusively. Through a careful analysis of AWQMD, discharge monitoring reports, and assessments of the biological community Virginia determined that excessive levels of phosphorous are causing the degradation of the benthic community in the UT Chickahominy River. The Commonwealth does not have numeric criteria for phosphorous at this time. Therefore, a numeric endpoint had to be established for the stream. It was decided that the goal would be to have a chlorophyll a concentration of 20 ug/l in the downstream pond. A chlorophyll a concentration of 20 ug/l equates to a TSI score of 60. This goal corresponds to Virginia's 303(d) listing guidance which calls for lakes to be listed for DO if their TSI score is above 60.

The GWLF model was selected as the means to determine loadings to the streams. The GWLF model provides the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).⁷ GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.⁸ Calculations are made for sediment and sediments based on daily water balance totals that are summed to give monthly values. The GWLF model was calibrated to the flow data from USGS gauge 02036500 on Fine Creek. It was calibrated for a 10 year period and transferred to the UT Chickahominy River.

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2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the level of nutrients to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis since it is the annual loading that impacts the community the greatest.

Waste Load Allocations

Virginia has stated that there is one facility discharging nutrients to the UT Chickahominy River. The Tysons facility is a poultry processing plant and as such nutrients are contained in its effluent. The TMDL requires the facility to reduce the nutrients in its discharge significantly for the stream to meet criteria. The existing load for this facility is 1,280 lbs/year and can be determined by multiplying the design flow (1.4 million gallons per day) by the monthly average concentration limit for phosphorous of 0.3 mg/l. The TMDL calls for this load to be reduced to 409 lbs/yr. Table 2 documents the waste load allocation (WLA) for the Tysons facility.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2 - Phosphorous WLAs for the UT Chickahominy River

Facility	Permit Number	Existing Load (lbs/yr)	TMDL Load (lbs/yr)
Tyson's Foods Inc.	VA0004031	1,280	409

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the GWLF model to represent the impaired watershed. The GWLF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. GWLF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segment from the various landuses within the watershed. Table 3 provides the LA for all of the nonpoint sources of phosphorous.

Table 3 - LA for Phosphorous for the UT Chickahominy River

Landuse	Existing Load (lbs/yr)	LA (lbs/yr)	Percent Reduction
Pasture/Hay	3.09	0.99	68
Cropland	6.17	1.98	68
Transitional	9.26	2.96	68

Forest	0.44	0.44	0
Urban	12.57	4.02	68
Groundwater	9.04	9.04	0
Wildlife	12.24	3.92	68

3) The TMDL considers the impacts of background pollution.

The TMDL approach inherently considers the impact of background pollutants by considering the phosphorus load from all landuses, including forested lands, within the impaired watershed.

4) The TMDL considers critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the impaired segment is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards⁹. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition when the ability of the waterbody to assimilate pollutants without

⁹EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

exhibiting adverse impacts is at a minimum.

The GWLF model was run over a multi-year period for the monitored watershed to insure that it accounted for wide range of climatic conditions within the watershed. The allocations developed in the TMDL will therefore insure that the criteria is attained over a wide range of environmental conditions.

5) The TMDL considers seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Pollutant loadings also change during the year as vegetation grows making it more difficult for nutrients to runoff. Consistent with the discussion regarding critical conditions, the GWLF model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and modifying the soil loss equations based on the time of the year.

6) The TMDL includes a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia includes an implicit MOS through the use of conservative modeling assumptions.

7) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

8) The TMDL has been subject to public participation.

There were two public meetings for the UT Chickahominy River TMDL. Both meetings were noticed in the Virginia Register, subject to a 30-day comment period, and held in VADEQ's Piedmont Regional Office. The first meeting was held on November 24, 2003 and the second meeting was held on March 17, 2004. Less than 10 people (not including VADEQ staff) attended each of these meetings. Tysons Food sent in written comments.

